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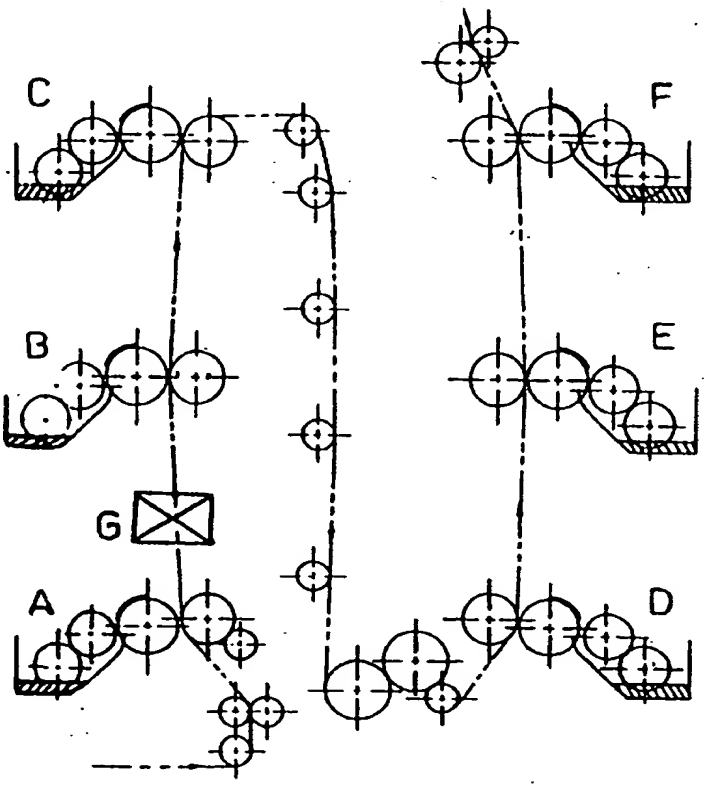
(54) Title: COATING IN CONNECTION WITH PRINTING AND COATING COMPOSITION WITH BARRIER PROPERTIES

(57) Abstract

The invention relates to a method for production of a material with barrier properties which prevents or reduces permeation of one or more substances from the group consisting of liquids, fats, water vapour and/or gases by coating with a composition. The characteristics of the invention are that the coating is done with a composition comprising a not completely polymerized, almost solvent-free, monomeric, oligomeric and/or polymeric composition in liquid state, in connection with printing of the material. The invention also relates to the use of a composition at coating of substrates which with said coating with the composition become partly or entirely protected against permeation of one or more subjects from the group consisting of liquids, fats, water vapour and/or gases. The characteristics of the use are that the composition comprises a not completely polymerized, almost solvent-free, monomeric, oligomeric and/or polymeric composition in liquid state.



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COATING IN CONNECTION WITH PRINTING AND COATING COMPOSITION WITH BARRIER PROPERTIES

TECHNICAL FIELD

The invention relates to a method for production of a material with barrier properties which prevents or reduces permeation of substances from the group consisting of liquids, fats, water vapour and/or gases by coating with a composition, and the use of a composition with barrier properties.

PRIOR ART

Coating of substrates, e.g. paper, board or plastic films, is done to improve the properties of these materials, as e.g. to improve printability or to impart barrier properties, i.e. protection against permeation of e.g. liquids, fats, water vapour or gases.

The term "coating" (of a substrate) refers to covering of a large part of the surface of the substrate, often the entire surface of the substrate. In the present invention this also comprises such covering with a layer to achieve barrier properties that, depending of the absorption of the material also can be called e.g. impregnation. Examples of coated packaging materials are Tetra´s milk cardboard boxes and certain bread packages.

Materials with barrier properties , e.g. packaging materials are often manufactured in different mills; rawmaterials in one mill, coating with a layer in a second mill and printing and finishing in a third mill.

The reasons why coating of papers (except for type clay coating to improve base papers printability and appearance) seldom takes place in a paper machine are that paper machines compared to coating machines are tremendously more productive and have

much higher capital costs, and therefore a complicated coating, in small series, in line, in the paper machine, would create too many adjustments with great brokes and many shut downs and extended stopping times as a result, which unfavourably would affect the economy of the paper machine.

The reason why coating of packaging papers seldom takes place in a printing press is amongst other that printing of packaging papers is often done in gravure printing and/or flexographic printing arranged for printing only on one side. This means that if the coating takes place in these common printing presses, and the coating takes place in one or more of the permanently arranged or modified printing units at the same time as printing is taking place in one or more of the other printing units, printing and coating takes place on the same side, which means disturbing interactions between printing inks and the mixture of coating chemicals. Alternatively rebuilding or rearrangement of the printing presses are necessary. The only used method for "simultaneous" coating with barrier layers and printing is at extrusion of thermo plastics, e.g. polyethylene on paper, whereby a small portion of the coated paper or board is printed in line in the extruder.

This production of packaging paper in different mills and at least in different machines leads to, because the end user often demands different qualities, widths, grammages etc large extra transportation costs and large storage costs at the printing mill depending on all this different qualities.

Known methods for paper coating to impart barrier properties includes coating of the paper with a dispersion, suspension or solution of, usually, a plastic material, after which the water or the solvent is removed and the coating is heat treated. This results in a barrier layer on the paper. This method involves large apparatus for evaporation, large energy consumption, if needed solvent recovery, possibly environmental pollution and, if water is used, quality problems due to dimensional changes in the paper.

Known methods for paper coating to impart barrier properties to the paper also includes extruding of a plastic layer on the paper or laminating the paper with one or more substrates. The problems with this method are amongst others that it presents a laminated material which is more difficult to recover than a more "homogenous"

material. Recovering or recycling of packaging materials has nowadays also got a "price label" because the supplier of packaging materials are in many countries responsible for the recovery of these (the supplier "has to" join an organization which administrates and handles the recovery of the packaging material and he therefore suffers from costs which are proportional to the difficulties to recover the packaging material, see for example the German DUALES SYSTEM).

Known methods for paper coating to impart barrier properties to paper also includes coating with e.g. a meltable wax or a meltable paraffine, optionally mixed or combined with other compounds, which in melted condition is coated on a moving paper web and thereafter is allowed to solidify on the substrate in the coating machine during the passage of the material over chilled rolls. Thereby e.g. a barrier coating can be achieved. The quality of such coatings are often bad, because the barrier properties are not satisfying.

Known methods for paper coating also includes radiation curing by coating with compositions comprising generally solvent free, not completely polymerized, monomeric-, oligomeric- and/or polymeric compositions which polymerize primarily influenced by a catalyst formed by irradiation of the composition with high energy radiation whereby a in the composition included catalyst precursor form a catalyst, or the composition polymerize by some other mechanism influenced by high energy radiation. This technique results in immediate polymerization (curing) of the coated layer and can be used in a printing press. However no methods are known related to coating of a layer with barrier properties in connection with printing in a printing press. Methods for gloss laquering (overprinting) with radiation curing coatings are however known, such as US No 4 105 806, US No 4 331 704 and US No 5 084 095. From EP O 389 252 A2 is also known a method to treat a paper to achieve improved printing results at the following printing with oil based printing inks. From German laid open Patent Application 2 105 179 is also radiation curing printing inks known.

Although the previous herein above mentioned mainly concerns coating of paper, the techniques can also be used for e.g. textiles and plastic- or metallic films and in relevant parts also three dimensional objects.

BRIEF ACCOUNT OF THE INVENTION

The object of the present invention is a method for coating a substrate with a barrier layer, which protects against permeation of one or more substances from the group that consists of liquids, water vapour, fats and/or gases as e.g. oxygen and printing in connection with coating of the substrate and the use of a composition with barrier properties.

A specially preferred embodiment of the present invention is coating on materials comprising cellulose fibers as the material to be coated and printed. With materials comprising cellulose fibers are meant paper, paperboard, board etc. with grammages from 20 g/m^2 up to over 1.000 g/m^2, which of course can contain usual adjuvants and usual rawmaterial compositions.

The object of the invention is also the use of a composition with barrier properties.

The barrier layer shall protect, the in e.g. a packaging material enclosed goods against one or more substances from the group that consists of liquids, water vapour, fats and/or gases. This is achieved by coating the material with a composition comprising a not completely polymerized, almost solvent free monomeric, oligomeric and/or polymeric composition, whereby the coating takes places in connection with printing of the material.

The term "almost solvent free" refers in the present invention to a composition of chemicals almost free from solvents in the form of organic or inorganic solvents which also includes water. By solvent is meant also liquid substances which not in themselves solves the coating chemicals, but also completely or partly serves as a dispersion agent, suspending agent, carrier etc. The term "almost solvent free" refers accordingly to a coating composition resulting in a layer where almost all applied coating still is left on the substrate when the product of material and coating is ready and where accordingly, less then 10%, preferably less then 5%, more preferred less than 3% and most preferred

less than 1% of the applied coating composition leaves from the appliance of the coating composition until the product of material and coating is finished.

The term "in connection with printing" refers in the present invention to the process that the material is coated and printed without intermediate storing e.g. in the form of sheets or reels or in any other way between the coating and the printing, or between the printing and the coating.

The coating in connection with printing of a packaging material according to the invention takes place with a composition comprising a not completely polymerized , almost solvent free monomeric, oligomeric- and/or polymeric composition, if needed containing catalyst(s), catalyst(s) precursor(s), chain creating or cross linking agents and/or radical generators. The composition generally polymerizes influenced by irradiation with high energy radiation. The method with radiation initiated polymerization results, after the irradiation after the coating, in immediate polymerization (curing) of the coated layer. The invention also comprises coating in connection with printing with compositions comprising other not completely polymerized, almost solvent free, catalyst containing, monomeric-, oligomeric- and/or polymeric compositions which polymerize without high energy radiation of UV-type or electron beam radiation, as e.g. influenced by e.g. heat, and coating in connection with printing with not catalyst(s) containing, not completely polymerized, almost solvent free monomeric-, oligomeric- and/or polymeric compositions.

The term coating of a material refers to a process whereby a large area of the surface of the material, often the entire surface, but generally more than 50% of the surface is covered. In the present invention is also included such surface coating with a layer to achieve barrier properties which, depending of the absorption of the material, also can be referred to as impregnation.

The coating in connection with printing of packaging materials according to the inventio takes place in a printing press with e.g. gravure printing-, typographic printing- (e.g. letterpress printing or flexographic printing), offset printing-, screen printing-, tampon printing (swedish:tampongtryckmetod), ink-jet printing- ond/or laser printing methods.

The coating may be carried out in one or more modified printing units in a multicolour printing press, or the printing press can be supplied with one or more further units. The coating may be carried out on the not printed side or on the printed sida or on both sides, or if both sides are printed, on one side or both sides. The coating can take place before or after the printing. The coating with the coating composition can be carried out with conventional equipment as e.g. flexographic-, or gravure units, or roll coating units with one or more coating rolls, e.g. with a reverse roll method. The coating can also be carried out with a meyer bar-, a blade coating- or an air brush coating equipment.

The coating according to the invention comprises coating with a composition comprising a not completely polymerized, almost solvent free monomeric-, oligomeric- or polymeric composition. The composition may contain a catalyst and/or catalyst precursor and/or a cross linking or chain initiating agent and the composition can either be polymerized influenced by the surrounding atmosphere, light, radiation, or by storing.

As examples of main components in the coating composition according to the invention can be mentioned vinyl- and/or vinylidene prepolymers, acrylates and/or epoxides , acrylated urethane silicones and acrylated epoxi silicones, siloxanes and urethanes. The coating composition can beside one or more of the above mentioned ingredients contain paraffines and/or natural or synthetic waxes and/or other adjuvants as e.g. inorganic or organic fillers, softeners, dying agents, opacity increasing agents etc.

Radiation according to the present invention includes UV-radiation or near UV-radiation e.g. between 100 nm and 600 nm, preferably between 200 and 400 nm, with an output between 100 and 800 W/cm material (web) width, preferably between 200 and 600 W/cm and more preferred between 200 and 400 W/cm. The radiation also includes electron beam radiation. Depending on the type of coating, dosages between 0,5 and 6 Mrad may be needed, preferably between 1 and 4 Mrad, whereby Mrad is the radiation dosage absorbed by the material (1 Mrad = 10 kJ/kg). Depending on the thickness of the coating, the electrons may then need to be accelerated in a field upp to 175 kV.

If radiation is used for polymerization, the coating is preferably irradiated immediately after the coating or at least before the material is stored e.g. in the form of sheets or reels or before it becomes wind up.

The irradiation can be carried out with conventional equipment, e.g. one or more UV (or near UV) generating devices, e.g. arranged over the width of the material, whereby the UV- light may be focused with a mirror or mirrors, or with an electron beam irradiator.

If needed inertization of the coated surface can be done with e.g. N_2 in connection with the irradiation.

The coating weight may vary according to the degree and kind of desired barrier properties, but is generally in the range of 0,3 g/m^2 up to 25 g/m^2, preferably 0,4 to 15 g/m^2 and more preferred from 0,5 to 5 g/m^2.

The advancing speed of paper materials to be coated can, when UV-technique is used to cure coatings, be between 20 and 200 m/min, preferably between 50 and 150 m/min and most preferred between 70 and 120 m/min. By using electron beam technique to cure coatings the speed may be between 50 and 400 m/min, preferably between 100 and 300 m/min and more preferred between 150 and 200 m/min.

The printing may be carried out by using water based or solvent based printing inks. The printing may as usually be carried out with one or more colours and with a covering degree from 0 to 100 % of the surface of the substrate. The printing is preferably carried out on only one side of the material.

The coating and printing can be carried out with the starting material in reels or sheets and with the end product in reels or sheets.

The present Patent Application comprises, even though plane materials such as paper has been taken as an example, also other fiberbased materials such as textiles and not fiberbased material such as e.g. plastic films and also three dimensional items.

The method according to the invention offers, by using UV-curing coating compositions to achieve a barrier layer, the following advantages:

- App. 90% energy savings compared to dispersion coating
- No dimensional changes of the fiber material
- No pollution of solvents since almost no solvent is used
- No space demanding drying equipments
- Only small modifications of the printing press since UV-irradiators and electron beam irradiators respectively are small
- Less storage keeping of raw materials
- Less transportation costs of materials
- The coated material is easier to recover than conventional polyethylene coated materials
- Also heat sensitive materials such as plastic films can be coated

Further characteristics and aspects of the present invention will be better understood from the appended claims and from the following description of embodiments.

BRIEF DESCRIPTION OF FIGURES

Fig. 1 shows a flexographic printing unit (typographic unit);

Fig. 2 shows a six-colour flexographic printing press of so called CI (Central Impression) - type;

Fig. 3 shows the printing units in a six-colour flexographic printing press of so called stacktype;

Fig. 4 shows the printing units in a flexographic printing press of the stack type arranged for printing on both sides;

Fig. 5 is a schematical view of a UV-curer;

Fig. 6 shows the spectral distribution of the light from a lamp generating UV-light;

Fig. 7 is an exploded view of an electron beam curer;

Fig. 8 shows a flexographic printing press arranged for coating on one side and printing on the other side, with the coating being done before the printing;

Fig. 9 shows a flexographic printing press arranged for coating on one side and printing on the other side, with the printing being done before the coating;

Fig. 10 shows a flexographic printing press arranged for coating and printing on the same side, with the coating being done before the printing; and

Fig. 11 shows a flexographic printing press arranged for coating and printing on the same side, with the coating being done before the printing, where the coating is made by a gravure printing unit.

DETAILED DESCRIPTION OF SOME EMBODIMENTS OF THE INVENTION

At the carrying out of the examples of embodiments below is a bleached MG kraft paper with a grammage of 80 g/m^2 used. The paper was coated on the raw side and was printed on the smooth smide and was printed and coated on the smooth side respectively. The paper was printed and coated from reel to reel and had a width of 1.200 mm. The printing was a fully covering 3-colour square pattern where the colours were situated beside each other, and with a side length of the squares of 1 cm. The printing covered 65% of the surface of the paper. The coating was made as a fully covering layer. An uncoated and unprinted edge of 1 cm was left as normally at the outer edges of the paper web.

The printing inks were ordinary water based standard flexographic inks. The three colours used in each example were black, yellow and cyan.

As printing press in the examples a flexographic printing press of the stack press type was used, whereby the coating was executed in one of the existing printing units except for one case, when a gravure printing unit was used for the coating. A flexographic printing unit comprises as is shown in **Fig. 1** an inked plate cylinder 3 which print on the paper 1 when the paper is passed between the plate cylinder 3 and an impression cylinder 2. The plate cylinder 3 receives its ink from a cylinder 4 which is provided with "microscopical" cell cavities filled with ink, where the amount of ink is determined by the shapes of the cells. The cylinder 4 in its turn receives its ink from a fountain cylinder 5

which rotates in a fountain 6 filled with ink 7. A printing press includes generally several printing units and because all the plate cylinders and impression cylinders in the printing units must have exactly the same periferal speed, all the impression cylinders in all printing units are connected together directly via a number of gears so that the cylinder 2 causes the cylinder 3 to rotate, which in its turn rotatetes the cylinder 4 which rotates the cylinder 5.

The printing units can in another type of a flexographic printing press also have a common, large impression cylinder as is shown in in **Fig. 2** where the printing units are arranged around the common, large impression cylinder. As can be seen in **Fig. 2**, coating on one side and printing on the other side is impossible without rebuilding in such a press.

Fig. 3 shows a flexographic printing press with printing units as according to **Fig. 1** where the printing units are situated separated with a distance from each other (a so called stackpress) but connected to each other because all impression cylinders are directly connected to each other with gears.

Fig. 4 shows the same flexographic press as in **Fig. 3** but arranged for printing on both sides of the paper, or printing on one side of the paper and coating on the other side of the paper. The changeover is not simple because one needs an extra set of guide rolls, an entirely new webpath and changing and regrouping of the gears that still must connect all the impression cylinders. This description of a press arranged according to **Fig. 4** and the flexographic press according to **Fig. 2** illustrates some of the difficulties with treatment (printing) on both sides of a material and is a part of the explanation why progresses in coating one side and printing on the other side not has taken place. Principally, the difficulties are the same in a gravure press, which is the other common type of printing press in a printing house for packaging materials.

Fig. 5 shows schematically a cross section of a UV-curer used in the examples. The UV-lamp 42 which is shaped as a pipe is situated at a certain distance from the paper web 41. The UV-lamp is on the side that is opposite to the paper, partly surrounded by a parabolic mirror 43 which focuses the light on a line 45 on the web 41. The parabolic

mirror 43 is provided with a shield 44 ventilated with cooling air. Behind the paper web is arranged a cooling plate 46, and the entire equipment is encased to cool, ventilate and get rid of ozone. In the examples below, two such UV-curer have been used, situated one immediately after the other. Each has an effect of 125 W/cm web width and a spectral distribution generally according to **Fig. 6**. The UV-curer is preferably equipped with a jalousie- or an aperture device which, when needed, can shield the paper web from the UV-lamp in order to prevent burning of the paper at low web speeds. If inertization is necessary, this can take place by e.g. blowing in nitrogen gas against the coated paperweb at the focusing place. The ventilated part of the UV-curer must hereby be shielded from the paper web by placing a for UV-light transparent quarts window between the UV-lamp and the paper web.

Fig. 7 shows the electron beam curer which has been used in the examples. The web 60 is irradiated with electron beams in the form of a "courtain" 61. The electrones are emitted from a source 62 and are accelerated by the device 63. 64 is a window e.g. made of a metal foil through which electrones are passing. 65 are shields. 66 shows the power input. In the examples a radiation dose of 1 Mrad (1 Mrad = 10 kJ/kg) has been used and an acceleration voltage of 175 kV.

In these trials has, as coating composition, been used a silicone acrylate composition: TEGO® Silicone Acrylate RC 450 from TH Goldschmidt AG, Essen, Germany. The composition has been used as it is when it was electron beam cured. When UV-cured there was added 7% of a photo initiator comprising dietoxi acetofenon from the same company. Inertization with nitrogen gas has been used at the curing places.

Example 1.

Coating and printing are carried out on different sides in a flexographic printing press arranged according to **Fig. 8**, and the coating and the polymerization under influence of UV-light takes place before the printing. The coating according to **Fig. 8** is done in the first printing unit A in the transportation direction of the paper web and printing is done in the last three units D, E och F. The other two printing units are not used. The polymerization takes place in the device G immediately after the coating unit A.

Example 2.

Coating and printing are carried out on different sides in a flexographic printing press arranged according to **Fig. 8**, and the coating and the polymerization under influence of electron beams takes place before the printing. The coating according to **Fig. 8** is done in the first printing unit A in the transportation direction of the paper web and printing is done in the last three units D, E och F. The other two printing units are not used. The polymerization takes place in the device G immediately after the coating unit A.

Example 3.

Coating and printing are carried out on different sides in a flexographic printing press arranged according to **Fig. 9**, and the coating and the polymerization under influence of UV-light takes place after the printing. The coating according to **Fig. 9** is done in the third printing unit D in the transportation direction of the paper web and printing is done in the first three units A, B and C. The other two printing units are not used. The polymerization takes place in the device G immediately after the coating unit D.

Example 4.

Coating and printing are carried out on different sides in a flexographic printing press arranged according to **Fig. 9**, and the coating and the polymerization under influence of electron beams takes place after the printing. The coating according to **Fig. 9** is done in the third printing unit D in the transportation direction of the paper web and printing is done in the first three units A, B and C. The other two printing units are not used. The polymerization takes place in the device G immediately after the coating unit D.

Example 5.

Coating and printing are carried out on the same side in a flexographic printing press arranged according to **Fig. 10**, and the coating and the polymerization under influence of UV-light take place before the printing. The coating according to **Fig. 10** is done in the first printing unit A in the transportation direction of the paper web and printing is done in the last three units D, E och F. The other two printing units are not used. The polymerization takes place in the device G immediately after the coating unit A.

Example 6.

Coating and printing are carried out on the same side in a flexographic printing press arranged according to **Fig. 10**, and the coating and the polymerization under influence of electron beams take place before the printing. The coating according to **Fig. 10** is done in the first printing unit A in the transportation direction of the paper web and printing is done in the last three units D, E och F. The other two printing units are not used. The polymerization takes place in the device G immediately after the coating unit A.

Example 7.

Coating and printing are carried out on the same side in a flexographic printing press arranged according to **Fig. 11**, whereby however the coating takes place in a gravure printing unit C and the polymerization takes place under influence of UV-light before the printing. The coating according to **Fig. 11** is done in the gravure printing unit C before the printing and the printing in the last three units D, E and F. The other two printing units are not used. The polymerization takes place in the device G immediately after the coating unit C. The gravure printing unit comprises an impression cylinder 91, a gravured printing cylinder 92 provided with "microscopical" cell cavities filled with coating composition, where the amount of coating composition is determined by the shapes of the cavities. The printing cylinder 92 is rotating in a fountain 94 containing a coating composition 95 and the excess of coating composition is doctored by a doctor blade 93, whereby a well defined amount of coating composition is left on the cylinder 92 and is transmitted to the paper web by the cylinder 92.

Example 8.

Coating and printing are carried out on the same side in a flexographic printing press arranged according to **Fig. 11**, whereby however the coating takes place in a gravure printing unit C before the printing and the polymerization takes place influenced by electron beams before the printing. The coating according to **Fig. 11** is done in the gravure printing unit C and printing is done in the last three units D, E och F. The other two printing units are not used. The polymerization takes place in the device G immediately after the coating unit C.

Table 1 summarizes the results achieved in the examples.

Table 1

	Coating weight (g/m^2)	Web speed (m/min)	Oxygen permeation resistance (%)*	WVP (g/m^2)	Fat resistance	Water penetr. $Cobb_{24}$** (g/m^2)
Raw-paper	-	-	not measured	120	None	120
Ex. 1	6	100	3	18	Excellent	1
Ex. 2	6	120	3	15	Excellent	0
Ex. 3	6	100	3	19	Excellent	1
Ex. 4	6	120	3	15	Excellent	0
Ex. 5	8	100	12	48	Traces	1
Ex. 6	8	120	12	23	Traces	0
Ex. 7	15	80	0,2	11	Excellent	1
Ex. 8	15	120	0,1	8	Excellent	0

WVP Water Vapour Permeability = the amount of water vapour per m^2 that has permeated the material when the "outside" atmosphere has a humidity of 75% RH.

Fat resistance = The material has been used as a packaging paper for margarine. Excellent means no permeation to the other side after storing during one week in room temperature.

* Percent oxygen content in a space that on one side is limited by 0,5 m^2 of the coated paper and on the other sides of oxygen tight metal foils, after one day, surrounded by air. The space was from the beginning filled with N_2.

** $Cobb_{24}$ ISO 535 (24 hours), the raw paper side.

CLAIMS

1. A method for production of a material with barrier properties which prevents or reduces permeation of one or more substances from the group consisting of liquids, fats, water vapour and/or gases by coating with a composition, characterized in that the coating is done with a composition comprising a not completely polymerized, almost solvent free, monomeric-, oligomeric- and/or polymeric composition in liquid state, in connection with printing of the material.

2. A method according to claim 1, characterized in that said material comprises cellulose based plain materials like paper, paper board, board, textiles and plastics and metal foils.

3. A method according to claim 1 or claim 2, characterized in that the coating, when the material only is printed on one side, is done on the side of the material that is not being printed.

4. A method according to claim 1 or claim 2, characterized in that the coating, when the material only is printed on one side, is done on the side of the material that is being printed.

5. A method according to claim 4, characterized in that the coating is done before and/or after the printing.

6. A method according to any of the preceding claims, characterized in that the coating is done on both sides of the material.

7. A method according to claim 1 or claim 2, characterized in that when the material is printed on both sides, the coating can be done on one side or on both sides of the material, optionally before or after the printing.

8. The use of, at coating of substrates which with said coating with a composition becomes partly or entirely protected against permeation of one or more subjects from the

group consisting of liquids, fats, water vapour and/or gases, a composition, characterized in that the composition comprises a not completely polymerized, almost solvent free, monomeric-, oligomeric- and/or polymeric composition in liquid state.

9. The use according to claim 8, characterized in that the composition further comprises polymerization initiating and/or polymerizing agents and/or precursors which by irradiation with high energy radiation like e.g. UV-radiation, electron beam radiation or γ-radiation, or by influence of high temperature, generate such agents.

10. The use according to claim 8 and claim 9, characterized in that the composition is used in connection with printing of the material.

Fig.1

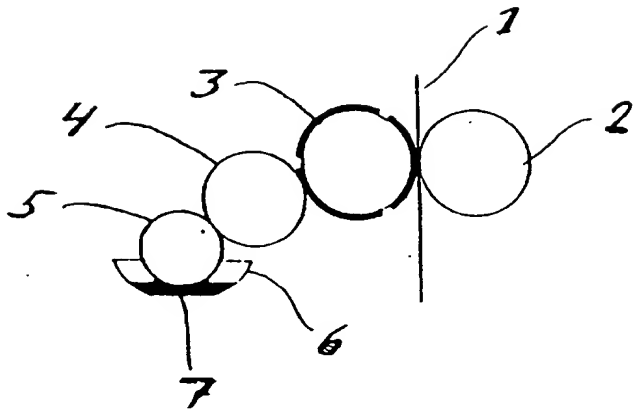


Fig. 2

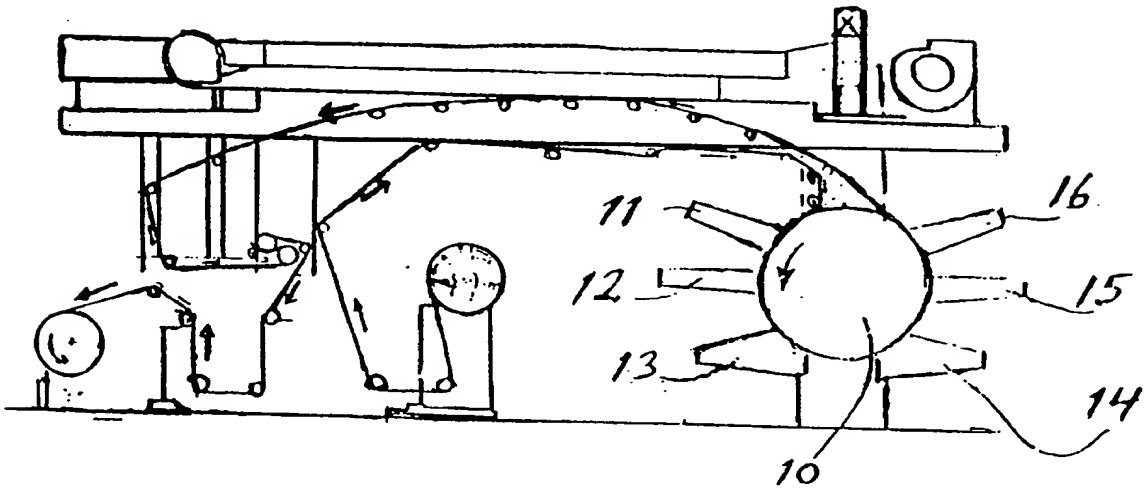


Fig. 3

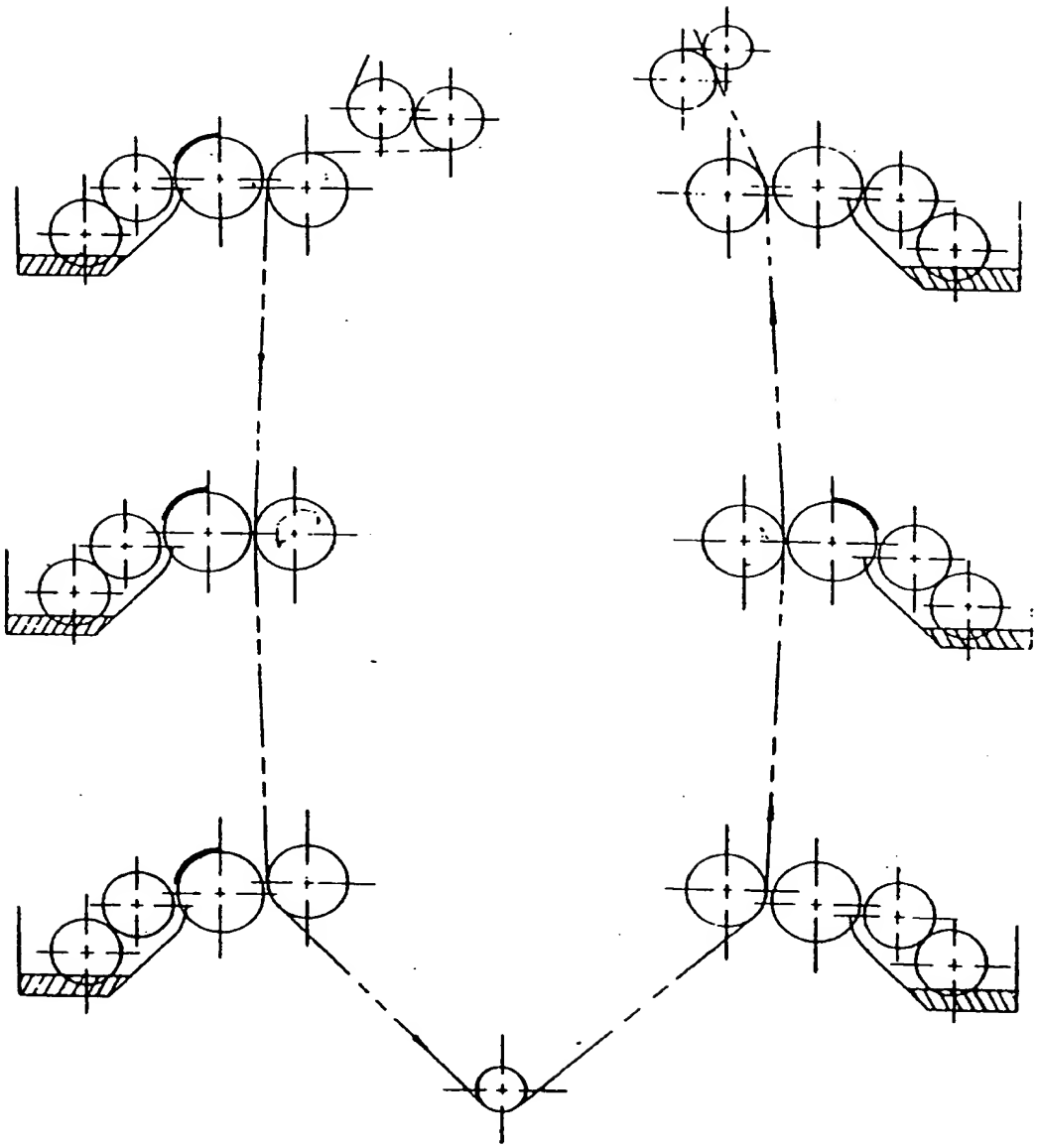


Fig. 4

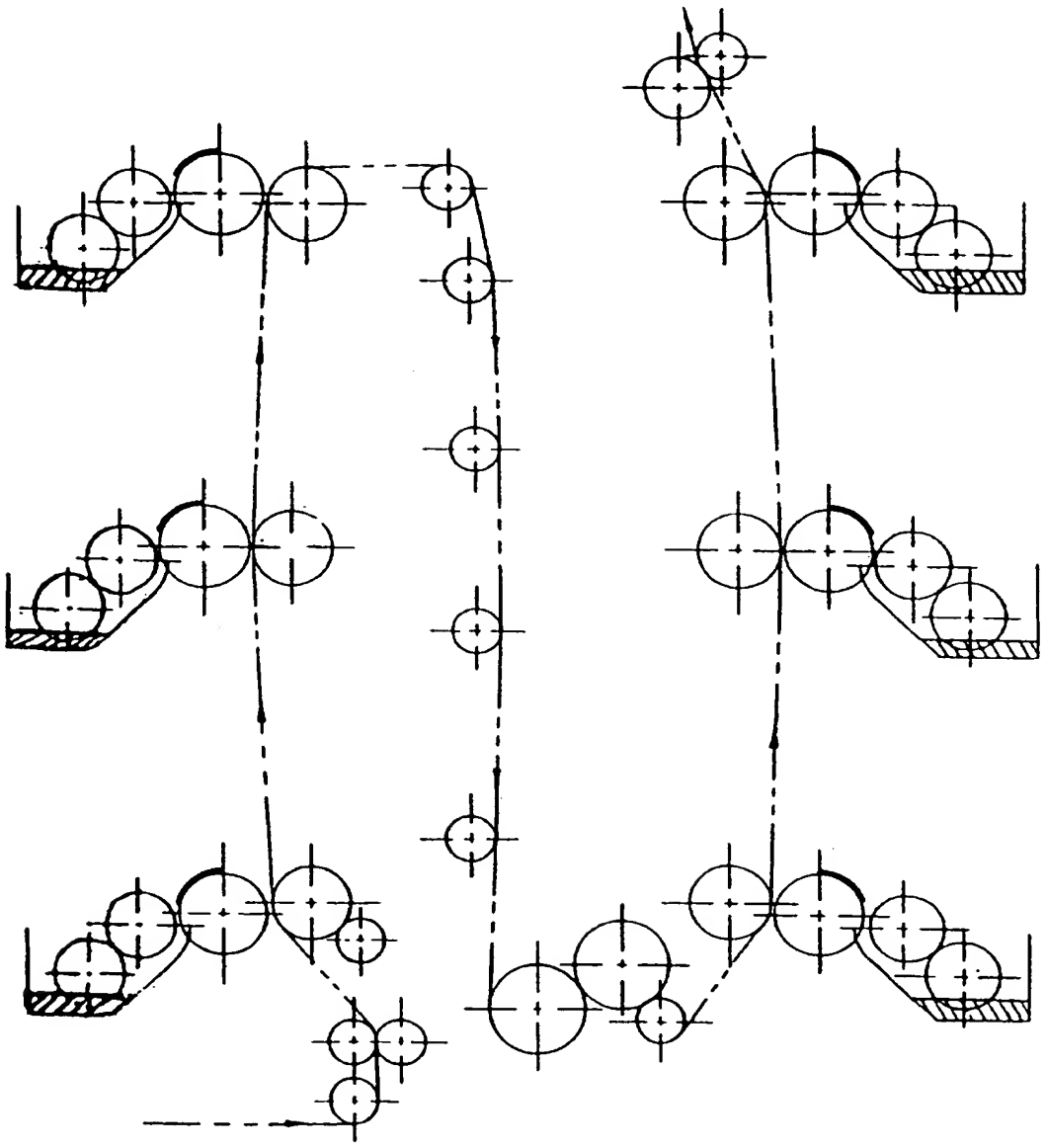


Fig. 5

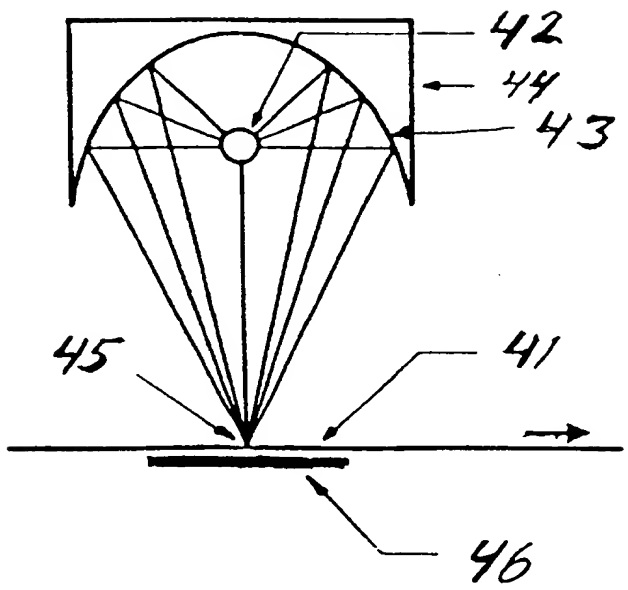


Fig. 6

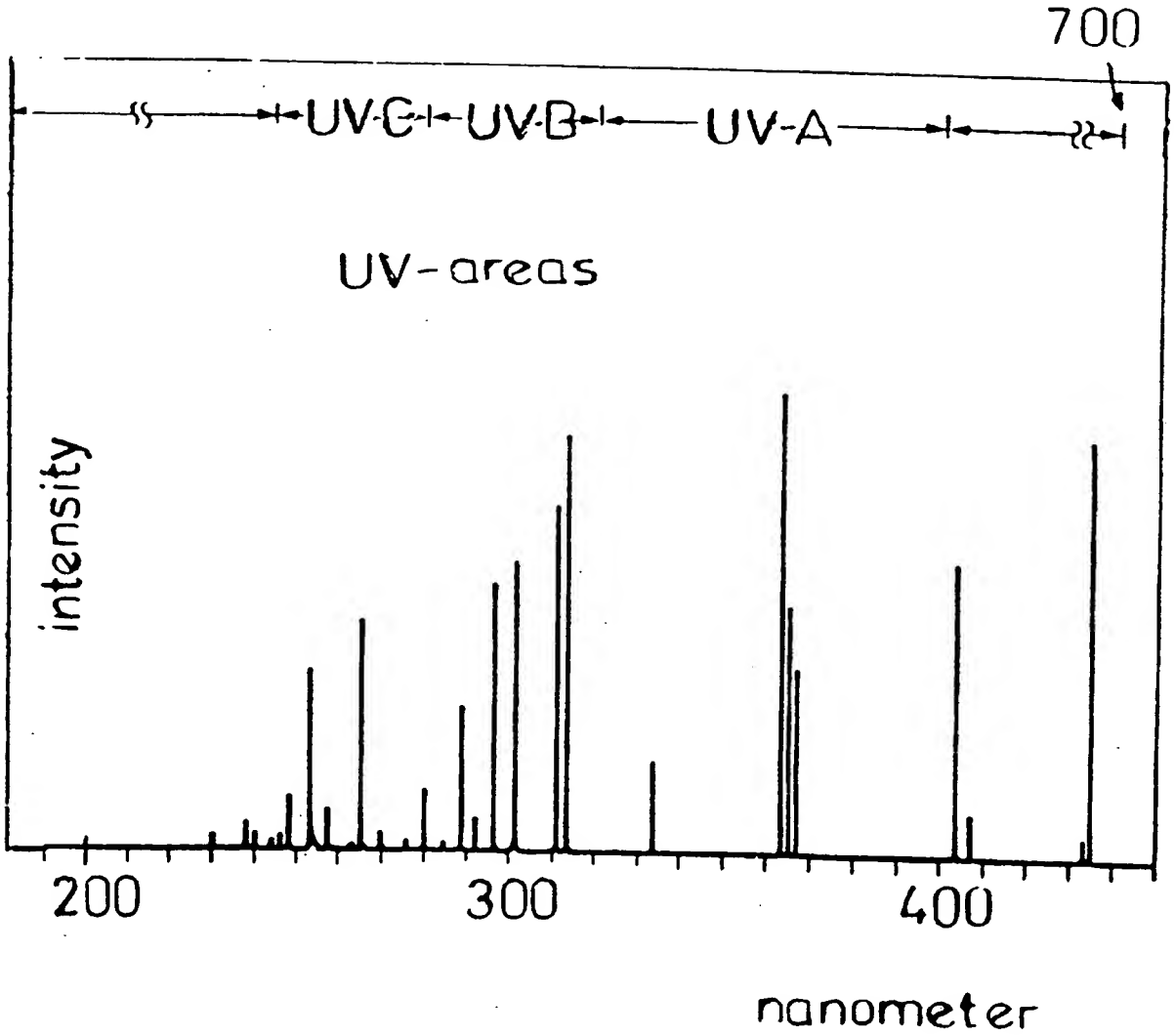


Fig. 7

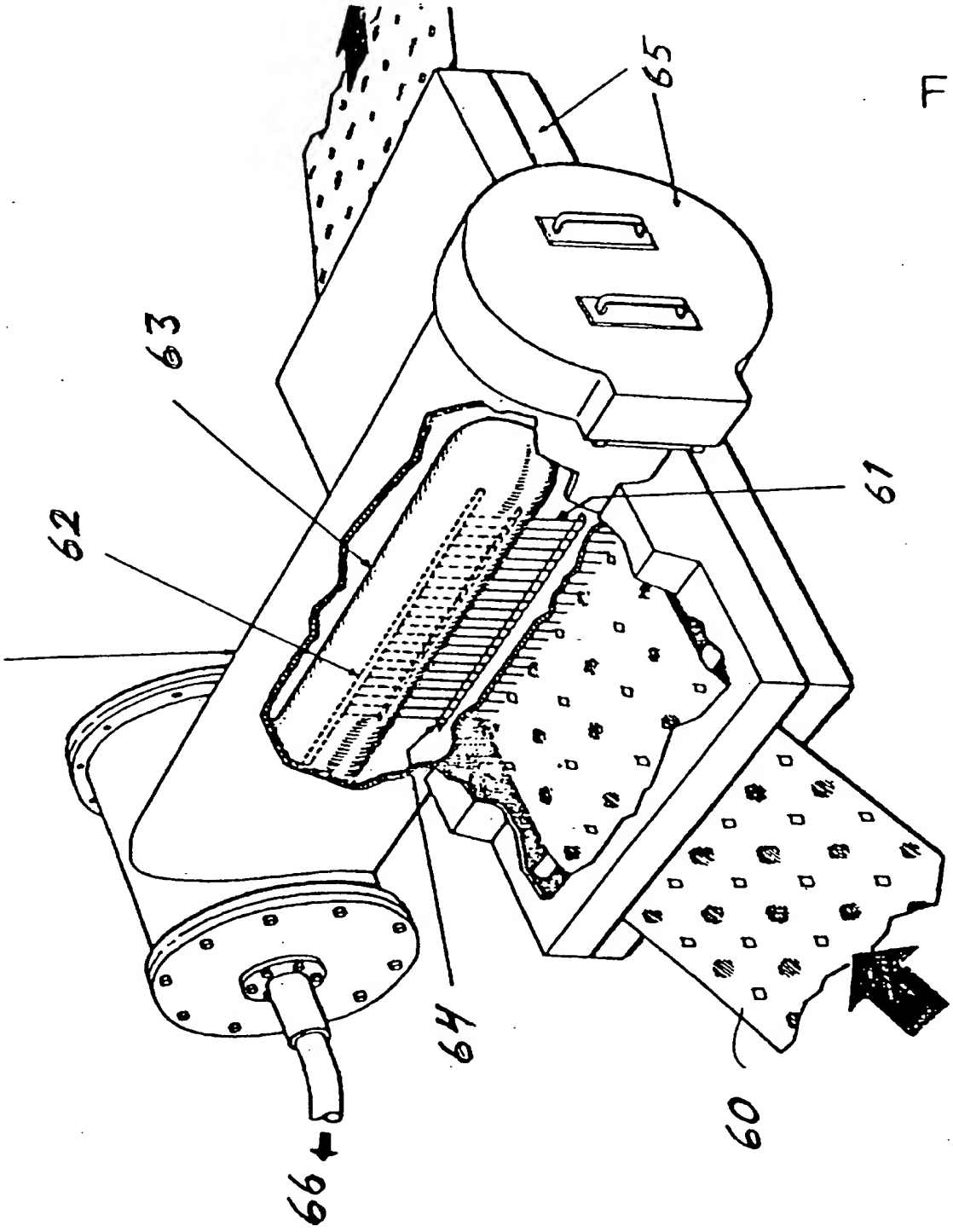


Fig. 8

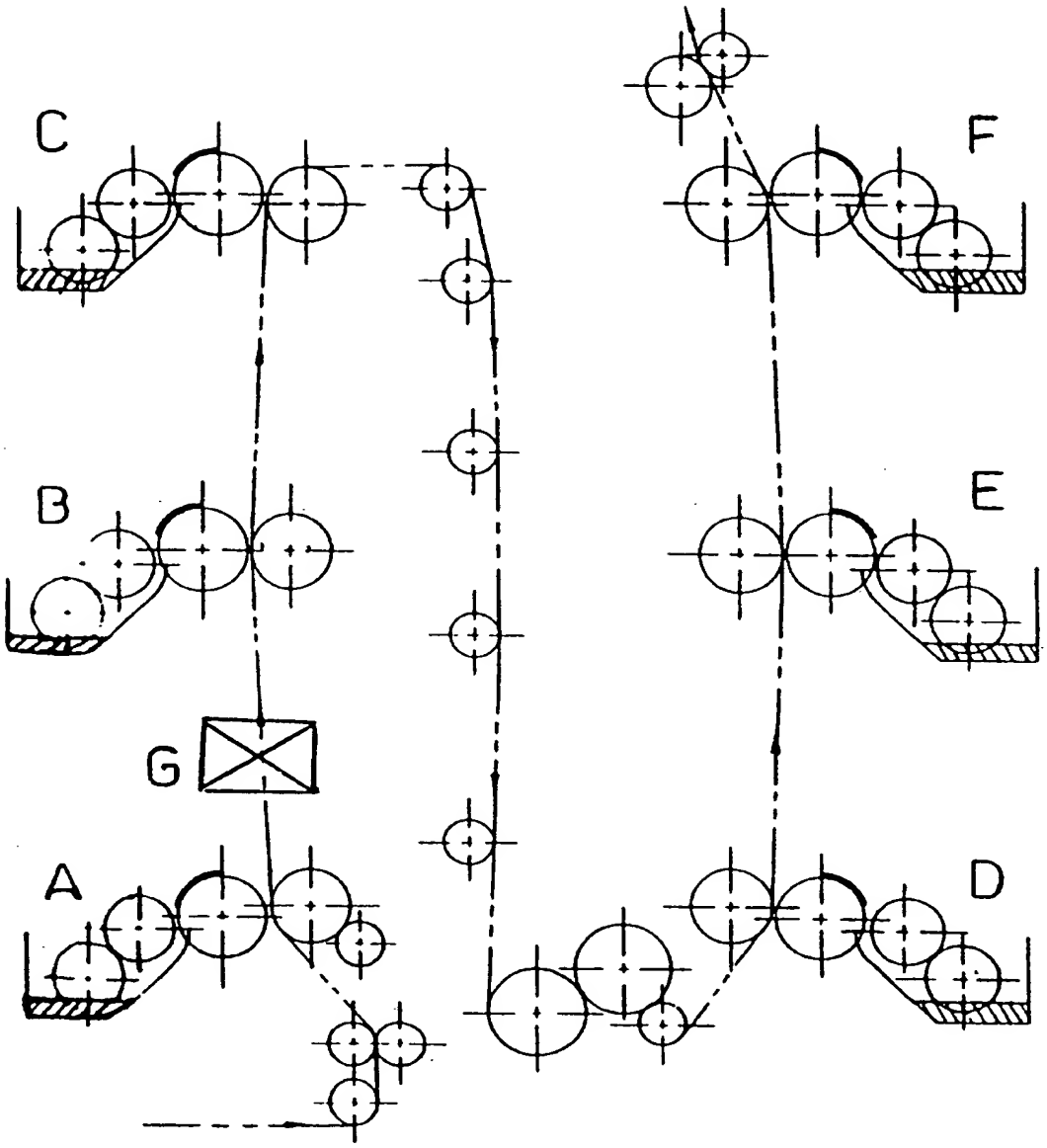


Fig. 9

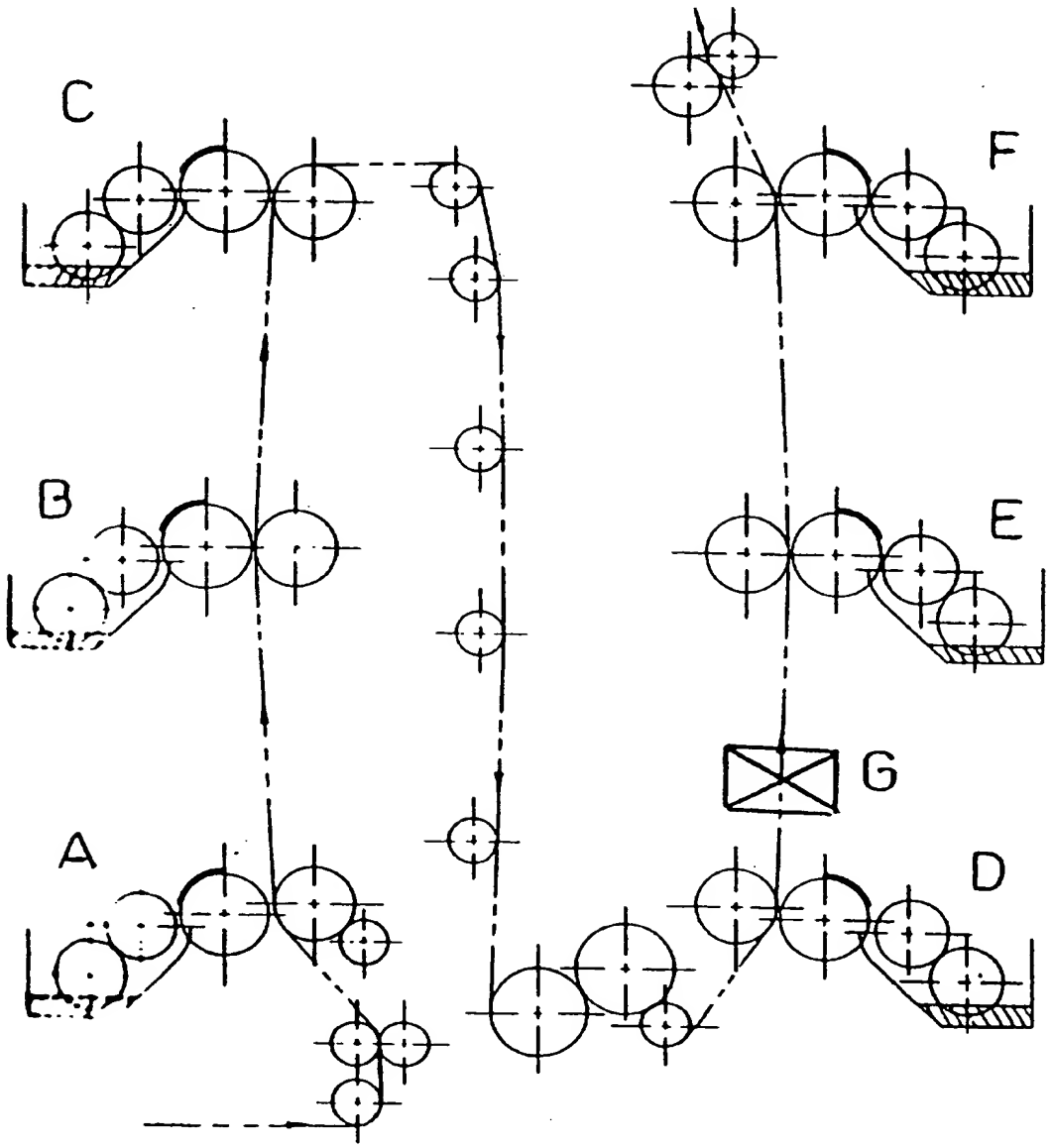


Fig. 10

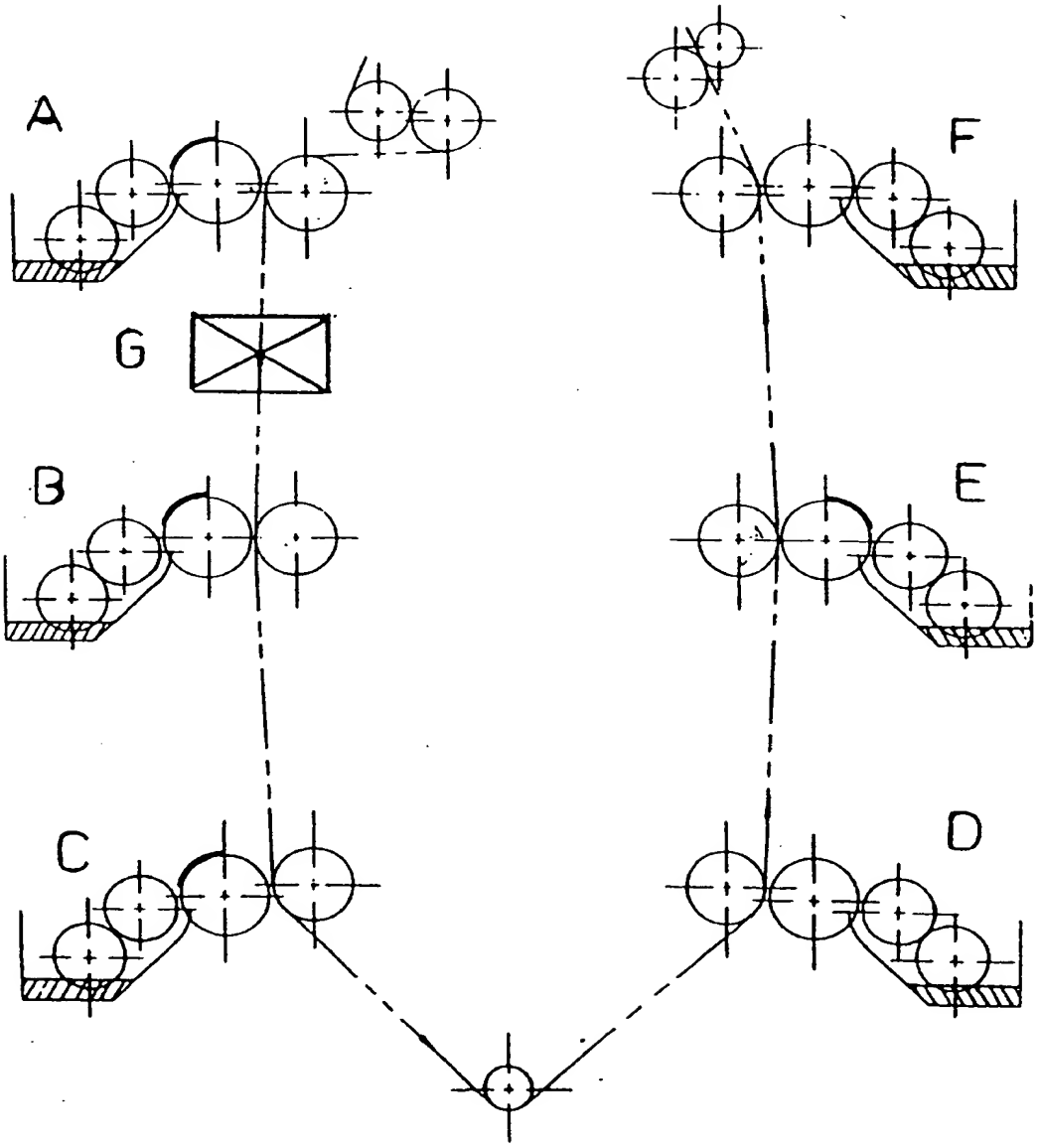
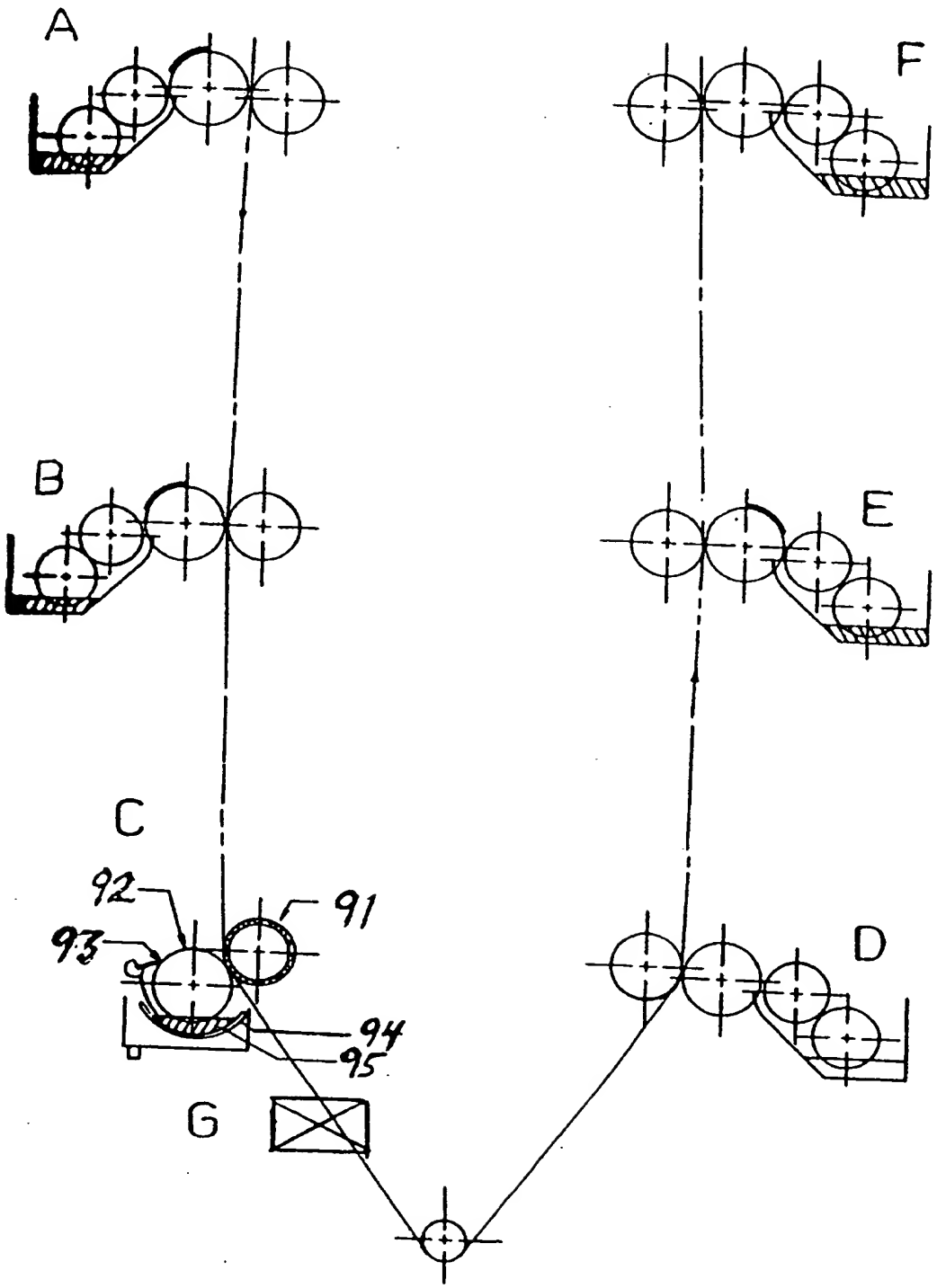


Fig. 11



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/00339

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B41M 7/00, B41F 23/00, D21H 19/16
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B41M, B41F, B65D, D21H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0389252 A2 (MURRAY, JOHN), 26 Sept 1990 (26.09.90), column 3, line 21 - line 25, figure 1	1,4,5,10
Y	EP 0343794 A2 (SAKATA INKUSU KABUSHIKI KAISHA), 29 November 1989 (29.11.89), page 1, line 7 - line 11, figure 1	1,4,5,10
Y	GB 2215274 A (VEB KOMBINAT POLYGRAPH"WERNER LAMBERZ"LEIPZIG), 20 Sept 1989 (20.09.89), figures 5,11	4,6

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 July 1996	19 -07- 1996
Name and mailing address of the ISA/ Swedish Pat nt Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Pia Hegele Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/00339

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5227414 A (G.D. ERNST ET AL), 13 July 1993 (13.07.93), column 2, line 46 - line 53	8
Y		10
	--	
X	DE 4007519 A1 (AEG KABEL AG), 12 Sept 1991 (12.09.91), column 1, line 1 - line 20	8,9
Y		10
	--	
A,P	US 5418008 A (B.C. CALVERT), 23 May 1995 (23.05.95), figure 6, abstract	1,8
	--	

INTERNATIONAL SEARCH REPORT

In ..national application No.
PCT/SE 96/00339

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Claims 1-7 and 10 relates to coating of a material in connection with printing of the material.

Claim 8-9 relates to coating of substrate with a chemical composition

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/07/96

International application No.
PCT/SE 96/00339

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A2- 0389252	26/09/90	NONE	
EP-A2- 0343794	29/11/89	DE-D,T- 68923485	22/02/96
		ES-T- 2076957	16/11/95
		JP-A- 2160590	20/06/90
		US-A- 5368891	29/11/94
GB-A- 2215274	20/09/89	DE-A,A- 3901174	17/08/89
		FR-A,B- 2626813	11/08/89
		JP-A- 1288443	20/11/89
US-A- 5227414	13/07/93	NONE	
DE-A1- 4007519	12/09/91	NONE	
US-A- 5418008	23/05/95	AU-B- 666632	15/02/96
		AU-A- 1136395	17/08/95
		CA-A- 2140597	25/07/95
		EP-A,A- 0664358	26/07/95
		FI-A,D- 950308	25/07/95
		HU-D- 9500214	00/00/00
		JP-A- 7267242	17/10/95
		NO-A,D- 950205	25/07/95
		PL-A- 306938	07/08/95
		US-A- 5425972	20/06/95
		CA-A- 2121309	17/10/94
		EP-A,A- 0622310	02/11/94
		JP-A- 7052944	28/02/95